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INNOVATING BEYOND MEDICAL SCIENCES WITH (INTERNET ON THINGS) IoT

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Abstract:- The development of molecular nanotechnology (MNT) carries numerous risks such as the production of potentially unhealthy nanoparticles, the possible creation of tiny, destructive, self-replicating robots, and many others. The Precautionary Principle is often invoked when dealing with situations that might be hazardous; however, the label "Precautionary Principle" is attached to at least two different ideas, which must be analyzed separately. This paper discusses two forms of the Precautionary Principle, which we will call the "strict form" and the "active form", and relates them to the purpose of the Center for Responsible Nanotechnology, and to CRN's policy recommendations.

Keywords- Precautionary Principle; Red biotechnology; Nanotechnology; Green biotechnology; Cognitive Science

INTRODUCTION

Areas

Areas such as biotechnology, nanotechnology, and cognitive sciences provide the right context in which IoT (Internet of Things) concepts can be embedded and will be used to provide solutions that can benefit society at large. Therefore, it encourages cross fertilization between IoT and these areas.

Biotechnology

In Biotechnology, biological systems and living organisms, parts of it, or their products are used in technical processes. Some biotechnological methods are quite old, but have not been understood for long time, e.g. using yeast to produce bread, wine or beer. Biotechnology builds on many other sciences such as microbiology, molecular biology, biochemistry, biophysics, genetics, bio informatics and process engineering.

The area of biotechnology is usually structured by application areas. **Green biotechnology** tries to improve plants or to use parts or ingredients of plants in new areas, for example in industry or medicine. If principles found in plants or organisms are transferred to technology, it is also called **bionics**. **Red biotechnology** aims at medical applications, which includes, for example, the development of medications, their production using genetically changed organisms or plants, gene therapy, tissue engineering, or the development of biochips for diagnostic purposes. Depending on the focus, it is also called **biomedicine** or **biopharmacology**. In **white biotechnology**, biotechnological methods are used in industrial production to reduce required energy, commodities, process steps and costs. Beside these three main application areas smaller and newer areas exist, for example grey biotechnology dealing with waste management which is clearly shown in Figure 1. Overall, the borders between the areas are continuous, and often results obtained in one area can be used in another one.

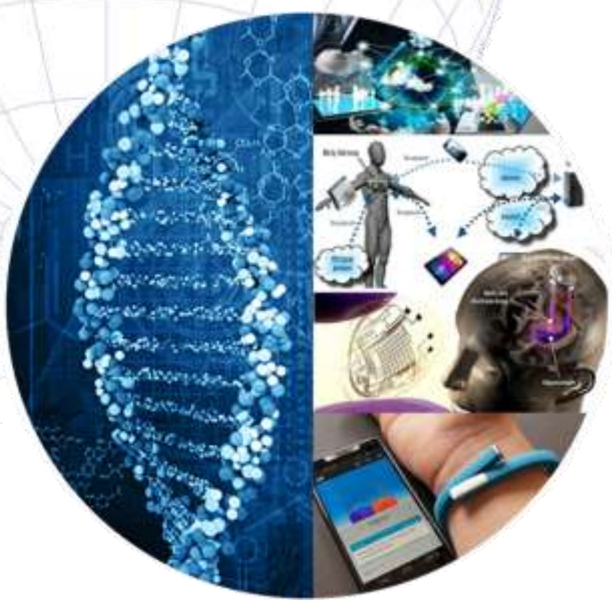

Fig. 1

Nanotechnology

Nanotechnology researches small systems of which with these small systems, quantum mechanical effects need to be considered, which make them behave differently than macroscopic systems. There are many examples in nature for nano effects, for example the lotus effect or the motion mechanism of some bacteria.

Two main approaches exist when engineering nanoscale systems. In the **top-down** approach, larger devices are used and/or material is removed from a larger block to create nanoscale devices as we shown in Figure 2. With the **bottom-up** approach, nanoscale devices are built from single atoms or molecules step by step.

Fig. 2

The wide field of nanotechnology is covered by several sub-areas of research, of which we name a few. **Nanomechanics** studies fundamental mechanical properties of nanoscale systems, but includes also the engineering of mechanical nanoscale systems, e.g. nano-motors. Closely related are **nanomaterials** aiming at researching materials with nanostructures that can be used, for example, in display technology, lighting, solar cells and biological imaging. In **nanoelectronics**, structures of electronic components like transistors are at nanoscale, which should result in even smaller chips, but also new optoelectronic devices, displays or memory. When combining nanoelectronics with nanomechanics, i.e. nanoscale sensors and/or actuators we get **nanoelectromechanical systems (NEMS)**. **Nanorobotics** aims at using nanoscale components to create robots in the size of 0.1-10 micrometers (Nanobots) that are able to move, sense, actuate, compute and communicate. When this assembly happens in a self-configuring way, it is called "Claytronics". The use of nanobots is manifold, e.g. in medicine where nanobots could be used in minimal-invasive surgery. **Nanoionics** studies fast ion transport in all-solid-state nanoscale systems. Finally, **nanophotonics** or **nanooptics** both looks at the optical properties of nanoscale systems and engineers optical devices at the nano scale level, e.g. optical switches.

Cognitive Science

Cognitive Science studies mental structures and processes. Cognition can be seen as processing, representing and transforming of information, which includes **perception**, i.e. the gathering, processing and representation of sensory information, **attention**, i.e. the filtering out of irrelevant information, **memory**, i.e. the storage and retrieval of information which can be both the performance of actions, episodic events and encyclopedic knowledge, **learning**, i.e. the building or modification of memory, **thinking**, including inference, i.e. the process of reasoning, and problem solving, **affects**, i.e. emotions, feelings and moods, of which the first two are reactions to events and their representation, and **motivation**, i.e. the building of intentions and goals. These processes can happen consciously or unconsciously. Also **language** is an important research field since learning, understanding and producing speech is a very complex process.

Due to the very interdisciplinary nature of cognitive science, several other research areas contribute to it, including psychology, philosophy, linguistics, anthropology, neuroscience, biology, sociology and computer science.

Since cognitive processes can be regarded as information processing, which can be abstracted to computational procedures, it is possible to apply the concepts also both to animals and artificial systems. The latter is also called **Artificial Intelligence** and includes both the simulation of natural concepts and the use of new strategies not found in nature to build intelligent agents.

Strongly related to cognitive science is **cognitive neuroscience** which studies the biological (mainly neural) mechanisms related to cognition. **Cognitive psychology** is mainly an experimental science which focuses on humans in all the information processing steps. Therefore, it is sometimes used as synonym for cognitive science. Although **man-machine interaction** (or more specifically **human-computer interaction**) is not an original research area of cognitive science, it applies theories and methods of cognitive science to the interaction between humans and machines/computers.

Conclusion:

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